

WHAT WE CLAIM IN THE INVENTION IS:

- 1 1. A method of forming an interconnect structure of a semiconductor
2 device, the interconnect structure having a dielectric material deposited over an
3 underlying interconnect layer and having a via extending through the dielectric
4 material for establishing a connection between an underlying conductor and a
5 trench in an upper portion of the dielectric material, comprising the steps of:
6 (a) forming a mask layer over the dielectric material;
7 (b) forming a via in the mask layer to a first predetermined depth
8 of the mask layer;
9 (c) forming a trench in the mask layer to a second
10 predetermined depth of the mask layer, which is not as deep as said first
11 predetermined depth of the via formed in the mask layer;
12 (d) forming a via through the dielectric material to the underlying
13 conductor, corresponding to the dimensions of the via formed in the mask layer;
14 and,
15 (e) forming a trench in the dielectric material to a predetermined
16 depth of the dielectric material corresponding to the dimensions of the trench
17 formed in the mask layer.
- 1 2. The method of claim 1 further including the step of removing a
2 predetermined amount of the mask layer from the semiconductor device and
3 leaving a film of the mask layer thereon over the dielectric material.
- 1 3. The method of claim 1 wherein said dielectric material includes a
2 via dielectric layer formed over the interconnect layer, a barrier layer disposed
3 between the via dielectric layer and the interconnect layer, a trench dielectric
4 layer formed over the via dielectric layer, and an etch stop layer disposed
5 between the trench dielectric layer and the via dielectric layer.

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1 4. The method of claim 3 wherein said step of etching the via includes
2 etching the via through the via dielectric layer and the barrier layer, and the step
3 of etching the trench includes etching the trench through the trench dielectric
4 layer.

1 5. The method of claim 4 further including the step of removing a
2 predetermined amount of the mask layer from the semiconductor device and
3 leaving a film of the mask layer thereon over the dielectric material.

1 6. A method of forming an interconnect structure using a mask layer
2 deposited over a dielectric material which has been deposited over an underlying
3 interconnect layer, comprising the steps of:

4 (a) forming a first mask film over the dielectric material having a
5 known set of etch properties;

6 (b) forming a second mask film over the first mask film having a
7 known set of etch properties different from the etch properties of the first mask
8 film;

9 (c) forming a third mask film over the second mask film having
10 etch properties substantially identical to the etch properties of the first film; and,

11 (d) forming a fourth mask film over the third mask film having
12 etch properties substantially identical to the etch properties to the etch properties
13 of the second mask film; and

14 (e) selectively etching the mask films in multiple steps to form
15 the interconnect structure.

1 7. The method of claim 6 further including the steps of forming a via
2 through the dielectric material to the underlying interconnect layer and forming a
3 trench within the dielectric material, to a predetermined depth of the dielectric
4 material.

1 8. The method of claim 6 further including the steps of forming the via
2 in the mask layer down to the first mask film and forming the trench in the mask
3 layer down to the third mask film.

1 9. The method of claim 8 further including the steps of forming the via
2 through the dielectric material and forming the trench to a predetermined depth of
3 the dielectric material.

1 10. The method of claim 8 further including the steps of forming a via
2 through the dielectric material, forming a trench in the mask layer down to the
3 first mask layer and forming a trench in the dielectric material to a predetermined
4 depth of the dielectric material.

1 11. The method of claim 10 further including the step of removing the
2 third and fourth mask films from the semiconductor device.

1 12. The method of claim 10 further including the step of removing the
2 second mask film, the third mask film and the fourth mask film from the
3 semiconductor device.

1 13. The method of claim 8 further including the steps of forming a via
2 dielectric layer over the underlying interconnect layer, forming a trench dielectric
3 layer over the via dielectric layer, forming an etch stop layer between the via
4 dielectric layer and trench dielectric layer.

1 14. The method of claim 13 the steps of simultaneously forming the via
2 through the etch stop layer and etching the fourth mask film from the
3 semiconductor device.

1 15. The method of claim 8 further including the steps forming a barrier
2 layer between the via dielectric layer and the interconnect layer.

1 16. The method of claim 15 the steps of simultaneously forming the via
2 through the barrier layer and removing the third mask film from the
3 semiconductor device.

1 17. The method of claim 16 further including the steps of forming the
2 trench through the trench dielectric layer, and simultaneously removing the etch
3 stop layer exposed within the trench and the second mask film.

1 18. A method of forming an interconnect structure using a mask layer
2 deposited over a dielectric material which has been deposited over an underlying
3 interconnect layer, comprising the steps of:

4 (a) forming a via dielectric layer over the underlying interconnect
5 layer,

6 (b) forming a trench dielectric layer over the via dielectric layer,

7 (c) forming an etch stop layer between the via dielectric layer
8 and trench dielectric layer;

9 (d) forming a barrier layer between the via dielectric layer and
10 the interconnect layer;

11 (e) forming a first mask film over the dielectric material having a
12 known set of etch properties;

13 (f) forming a second mask film over the first mask film having a
14 known set of etch properties different from the etch properties of the first mask
15 film;

16 (g) forming a third mask film over the second mask film having
17 etch properties substantially identical to the etch properties of the first film; and

18 (h) forming a fourth mask film over the third mask film having
19 etch properties substantially identical to the etch properties of the etch properties
20 of the second mask film.

1 19. The method of claim 18 further including the steps of forming a via
2 in the mask layer down to the first mask film and forming a trench in the mask
3 layer down to the third mask film, and the trench overlapping the via.

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1 20. The method of claim 19 further including the steps of forming a via
2 through the dielectric layer and the barrier layer corresponding to the dimensions
3 of the via formed in the mask layer, forming a trench through the trench dielectric
4 layer corresponding to the dimensions of the trench formed in the mask layer,
5 and said trench in the trench dielectric overlapping the via in the via dielectric
6 layer.

1 21. The method of claim 20 further including the step of removing the
2 fourth mask film and the third mask film from the semiconductor device.

1 22. The method of claim 21 further including the step of removing the
2 second mask film.

